THE BOTANICAL SOURCE OF PATAVA OIL

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In view of the considerable interest in the source and nature of patava oil exhibited in recent years by importers, customs officials, Department of Agriculture agents, and the United States Customs Court, it has been thought advisable to place on record in one easily accessible paper the chief sources of botanical and chemical information on this subject.

The botanical history of patava oil begins with Carl Friedrich Philipp von Martius, who apparently was the first European explorer to discover it, and who was the first botanist to describe and name the tree which produces it. Martius, in his "Historia Naturalis Palmarum", volume 2, page 23 (1823), describes the tree and names it *Oenocarpus bataua*. He illustrates it well on plates 24 and 25 in this work, and states that a greatly desired drinking decoction is secured from the fruit, extensively used by the local Amerinds and referred to by them as "bataua" (1). On page 21 of this same work Martius founds and describes for the first time the genus *Oenocarpus*, of which genus this was his second-mentioned species. The generic name, *Oenocarpus*, signifies "wine fruit", in allusion to the drink obtained from these trees.

The second reference to the plant is by Alfred Russel Wallace, who, in his "Palm Trees of the Amazon", page 127 (1853), reports that the vernacular name for *Oenocarpus bataua* among the natives of the regions where it grows is "patawá", that the fruit is edible and yields a drink, and that the spinose processes of the leaf-sheaths are used as arrows in native blowpipes. These arrows are 15 to 18 inches long and are dipped in curare before being used. He tells us that six species of the genus *Oenocarpus* were known to him, that they prefer dry slightly elevated land, and are not found above 1600 feet elevation. He describes *O. bataua* as a palm tree growing 50 to 60 feet in height.

Richard Spruce, in "Hooker's Journal of Botany", volume 6, page 334 (1854), has this to say: "After the Caiaué, as to quality of oil, come the various species of *Oenocarpus* (OE. *Bacaba*, *Batana*, *disticha*, etc.). The oil of these is apparently of finer quality than that of Caiauá [*Elais melanococca*]; it is colourless and sweet-tasted, and not only excellent for lamps, but for cooking. The shop-keepers of Pará buy Patana-oil of the Indians, and mix it with equal proportions of olive oil, retailing the whole as 'olive-oil', from which, indeed, even the best judges can scarcely distinguish it. I can bear testimony that, for frying fish, oil of Baccaba is equal either to olive-oil or butter. The various species of *Oenocarpus* abound on the Amazon and Orinoco, and on their tributaries. I have lately seen the Patana in the greatest plenty throughout the Casiquiare, Alto Orinoco, and Cunucunuma. Near the Barra it is frequent, but less so than the Bacaba. The forests opposite San Carlos, extending from the Rio Negro to the Xié, are literally sown with Patanà. The fruit is in season nearly all the year round. We are just now beginning to make use of it, and we shall have it (in unlimited quantity, if there were always Indians to climb the trees) all along until November. I am passionately fond of Pataná-yukissé, and it is the only thing which I shall regret when I leave San Carlos. When I have passed a long time without drinking it, and recommence, I always find it slightly aperient, but this effect passes off in two or three days." This letter was dated at San Carlos del Río Negro, Venezuela, March 19, 1854.

Next we find mention of it by Berthold Carl Seemann in his "Die Palmen", pages 186--188 (1863) where he states that all the palms that belong to the cocoanut tribe produce fruit which contains oil. The genus *Oenocarpus* shares this latter characteristic, even though it is too widely unrelated to belong to this same tribe. He then quotes part of the passage from Spruce given above (2).

Carl Schaedler, in his "Technologie der Fette und Oele", edition 2, page 844 (1892), states that from the seeds of *Oenocarpus bacaba* and *O. bataua* of Central and South America is extracted "comu oil", "huile de comou", or "comou butter" which is used in the manufacture of soap and candles (3).

Otto Warburg, writing in H. Sempler's "Die Tropische Agrikultur", edition 2 by R. Hindorf, volume 1, pages 745--746 (1897), says: "25. Die Patavapalme. Manchmal wird dieser Name auf die aus etwa 17 Arten bestehende Gattung *Oenocarpus* angewandt; er sollte aber beschränkt bleiben auf die Art *Oe. Batava*. Die sämtlichen Arten zeigen Übereinstimmung darin, dass sie im tropischen Amerika heimisch sind, wo sie trockne Standorte auf Bodenerhebungen bis zu 500 Meter über dem Meersspiegel einnehmen. Es sind hohe, majestätische Bäume mit grossen glatten Stämmen und Fiederblättern. Die Blüten sind einhäusig, die Früchte nahezu kugelrund; letztere sind einsamig und haben geniessbares Fleisch. Die Früchte aller Arten liefern ein vorzügliches Öl, und wenn es in den grössten Mengen von der Patavapalme gewonnen wird, so geschieht es, weil dieselbe am zahlreichsten auftritt, zumal im [p. 746] Gebiete des Orinoco und Amazonenstroms. Dieses Ol wird höher geschätzt als dasjenige der amerikanischen Ölpalme; es ist farblos, von süsslichem Geschmack und kann nicht nur zur Beleuchtung, sondern auch in der Küche verwandt werden. Nur die Indianer machen eine Beschäftigung aus seiner Gewinnung, die, wie kaum erwähnt zu werden braucht, nach rohester Methode erfolgt. Trotzdem wird das Ol in Para zur Verfälschung von Olivelöl brauchbar befunden, was das beste Zeugnis für seine Qualität ist. Die Früchte werden ferner zur Bereitung eines sehr beliebten Getränkes benutzt, welches Yukissee genannt wird, übrigens ein Name, den die Indianer des Rio Negro allen Pflanzensäften, ja sogar animalischen Saucen geben. Das Verfahren dabei ist desselbe, welches ich bereits bei der Assaipalme geschildert. Wenn das Yukissee einige Zeit in einem Gefäss steht, steigt der Olbestandteil an die Oberfläche und giebt damit die Erklärung für die nahrhafte und schwach abführende Wirkung dieses Getränkes. -- Auch die Blätter und das Holz der Patavapalme sind verwendbar."

Five years later, E. Liénard, writing in the "Académie des Sciences, Paris, Comptes-rendus", volume 135, pages 593--595 (1902), reported that the endosperm of Oenocarpus bacaba contains mannite, galactose, saccharose, water, and oily substances. The following year E. Bassière, in the "Journal de Pharmacie et de Chimie", series 6, pages 326--329 (1903), reviews the history of the two species, bringing out again the fact that Spruce, Seemann, Warburg, and Schaedler all mentioned the production of oil by O. bataua and O. bacaba, that the oil is used not only for illumination, but also for cooking (4), that the oil is used frequently in Pará, Brazil, as an adulterant of and substitute for olive oil, and that the Amerinds on the Rio Negro make a drink from it called "yukissé". He claims that the oil contains 10.4 percent glycerin and 19 percent of acids whose molecular weight is 289.1.

Two years later a considerable contribution was made by J. Lewkowitsch in his "Chemische Technologie und Analyse der Öle, Fette und Wachse", volume 2, page 125 (1905), where he reports that "coumou oil" is secured from the kernels of Oenocarpus bataua and O. bacaba. The kernels were boiled in water by him, whereupon a light-yellow oil was separated. This oil he describes as only half volatile. The experiment, he says, yielded 4.3 percent of free fatty acids. The extraordinarily low saponification value which he found does not agree with the assertion of Bassière that his experiment yielded 10.4 percent of glycerin and that the molecular weight of the fatty acids amounted to 289.1. Also, this worker claims, the assertion cannot be correct that Bassière's experiment yielded only 19 percent of oil-acids. The melting point of the fatty acids is around 19°. (5)

In 1910 C. Grimme, in the "Chemische Revue über die Fett- und Harz-Industrie", volume 17, pages 232--234 (1910), is more definite about the constituents and characteristics of the oil. He reports that the flesh of the fruit is edible. The seeds, which in the dry state are light-brown on the outside and white on the inside, yield on extraction with ether 34.8 percent of a light-yellow somewhat volatile odorless oil with a pleasant taste. This is mentioned in literature under the names of "comuöl", "huile de comou", and "comou oil". Investigations by Grimme gave the following picture of the oil's characteristics: specific gravity 0.9248 at 15° C.; melting point -7.5°; solidifying point -9° C.; refractive index 1.4691 at 15° C.; p.H. or acid-value 1.40; computed free oil-acid 0.71 percent; saponification value 190.5; ester value 189.1; iodine value 80.0; fatty acids 96.6 percent; glycerin 10.33 percent; unsaponifiable material 0.76 percent. The fatty acids extracted from the oil are light-yellow and of a buttery consistency, with a melting point of 19.5° C., a solidification point of 17.8° C., a refractive index of 1.4502 at 45° C., a neutralization value of 190.2, an iodine value of 85.3, and an average molecular weight of 292.2. The residue of the oil has 32.15 percent protein (6).

Carl Wehmer, in his "Die Pflanzenstoffe", edition 1, page 73 (1911), reiterates that the kernels of the fruit of *O. bataua* yield a fatty oil called "comu oil", "coumou oil", or "patava oil", which is also obtained from *O. bacaba*. In the endosperm are various mannites, a galactose, and saccharoses. In the oil is found olein as well as glycerides, stable fatty acids, and free acids (7).

Four years later E. R. Bolton and E. M. Jesson, in the "Analyst", London, volume 40, pages 3--9 (1915), reported on their investigation of *Oenocarpus distichus*. They found the kernels to contain 7.1 percent of oil and the whole fruit 6.7 percent oil. This oil, they found, has a melting point of 36° C., a saponification value of 209.2, a refractive index of 49.0 at 40° C., an iodine value of 55.9, 65.9 percent of free fatty acids, and 2.15 percent of unsaponifiable matter.

G. H. Warburton's English revision of Lewkowitsch's "Chemical Technology and Analysis of Oils, Fats and Waxes", edition 6, pages 245--246 and 678 (1922), gives most of the same information contained in the 1905 work, adding the Italian name "olio di coumou" and the English "patava oil" (an obvious corruption of "batava oil"). He says that the fruit ripens all through the year, and quotes the figures reported by Grimme. In a chart (on page 678) of lesser known vegetable fats he includes *O. distichus* with the figures reported by Bolton and Jesson (8).

M. Burrett, in the "Notizblatt des Botanischen Gartens und Museums zu Berlin", volume 10, page 304 (1928), reviews the morphological characters of all the described species (9) of *Oenocarpus*, and segregates from this genus the new genus *Jessenia*, placing Martius' *Oenocarpus bataua* into this new genus. He repeats the statement that a popular drink is obtained from the fruits of this palm, which because of its strong oil content is difficult to digest (10). The genus *Jessenia* differs from *Oenocarpus* in having more than 6 stamens per flower and because of technical calyx and endosperm characters. The complete synonymy of the species, up to this point, then, is as follows:

Oenocarpus bataua Mart., Hist. Nat. Palmarum 2: 23, pl. 24 & 25. 1823; Drude in Mart., Fl. Bras. 3^2: 468, pl. 108. 1882; Barbosa-Rodriguez, Sertum Palmarum Brasiliensium 1: 45, pl. 41 & 42. 1903.

Oenocarpus batawa Wallace, Palm Trees of the Amazon 31, pl. 10 & 11. 1853.

Oenocarpus Batana Spruce in Hook., Journ. Bot. 6: 334. 1854.

Oenocarpus Batava Spruce ex Seem., Die Palmen 186. 1863.

Oenocarpus Patawa Schaedler, Technologie der Fette und Oele, ed. 2, 844. 1892.

Oenocarpus batana Mart. ex Lewkowitsch, Chemische Technologie und Analyse der Öle, Fette und Wachse 2: 125. 1905.

Oenocarpus batava Mart. ex Grimme, Chemische Revue über die Fett- und Harz-Industrie 17: 233--234. 1910.

Jessenia bataua (Mart.) Burrett, Notizbl. Bot. Gart. Berlin

10: 300--304. 1928.

In 1929 the second edition of Carl Wehmer's "Die Pflanzenstoffe" appeared. On page 124 of volume 1 he repeats the information given in his 1911 work and adds that the kernels of *Oenocarpus bataua* contain 4.8 percent of fatty oil. He also adds the data about *O. distichus* reported by Bolton and Jesson (11). On page 1322 he gives "*Oenocarpus* GR. (?)" as the source of a fatty oil.

In 1931 E. Stock reported on a new analysis in "Farbenzeitung", Berlin, volume 36, page 830. He described the oil as beautifully light-yellow, giving off no odor, and with a pleasant taste. It was designated as "Oenocarpus oil" and was said to have been extracted from a species of palm. The constants which he ascertained were as follows: specific gravity at 15° C. 0.9244; solidification point 7.5° C.; refractive index 1.4700; p.H. or acid value 1.38; saponification value 190.0; iodine value 80.6; unsaponifiables 0.84 percent. The oil yielded 96 percent of fatty acids. These exhibited the following characteristics: melting point 18.9° C.; refractive index at 45° C. 1.4492; iodine value 86.7. The oil can be rendered completely colorless through Fuller's-earth. Also, he says, we are here concerned with a slightly volatile oil, whose volatility can be increased by the addition of cobalt-siccative, but in his opinion the volatility is still not sufficient. (12)

In the same year F. W. Friese, in "Chemische Umschau auf dem Gebiete der Fette, Oele, Wachse, und Harze", volume 38, page 216 (1931), reported on some little-known Brazilian palm-oils (13). Here he lists oils from *Oenocarpus bacaba*, called "bacaba"; from *O. multicaulis*, called "bacaba y"; from *O. bataua*, called "batauá"; and from *O. discolor*, called "pindoba". He states that the oils from the first two of these are used locally for shampooing, cooking, and glossing, but are not usable industrially.

Liberty Hyde Bailey, in his "Standard Cyclopedia of Horticulture", volume 2, page 328 (1935), gives the following pertinent information: "*Oenocarpus* (wine fruit, as some of the species yield a beverage).....A few species of South American tall pinnatisect-leaved palms.....little grown but numerous in the Amazon and Orinoco countries.....some species yield useful oil. Fruit a medium-sized usually purple or black berry. *O. bacaba* Mart. and *O. bataua* Mart. are the species most likely to be mentioned."

In the "Ergänzungsband zur zweite Auflage" of Carl Wehmer's "Die Pflanzenstoffe", page 139 (1935), the data reported by Stock for his unidentified species of *Oenocarpus* are summarized, and Friese's paper is also noted (14).

Finally, in a bulletin entitled "Brazil, 1943", published by the Ministry of Foreign Affairs of that nation, it is stated that *Oenocarpus bacapa* Mart. is the source of a vegetable oil. Its density, solidification number, iodine number, and refractive index are given. It is said to be used in soaps and stearin.

We find, thus, that during the period from 1823 to 1943, the fact that an oil is obtained from species of *Oenocarpus* is mentioned by 17 recognized professional botanists or chemists (12 of whom mention *O. bataua* specifically). That the genus is the source of a drink is mentioned in 9 references, and that the endosperm is a source of mannites, galactose, and saccharose is mentioned in three. This ought definitely to answer the claims made in certain quarters that *Oenocarpus* palms are not oil-producing palms and that no such claims are extant in scientific literature. The exact quotations of the more important of these references are appended herewith as footnotes for the convenience of Customs Court lawyers and other interested persons, who may not have ready access to all of the original books and journals.

(1) "....ob fructus decoctione potum exoptatissimum praebentes India magni habita atque Bataua nomina salutat."

(2) "....alle zu den Cocoineen gehörige Palmen....ölspendende Früchte tragen. Die Gattung *Oenocarpus* theilt letztere Eigenschaft, obgleich sie weit entfernt ist zu den Cocoineen zu gehören. Spruce bemerkt, wo er von den Oelpalmen des Amazonenstromes spricht: 'Nach der Caiaué (*Elaeis melanococca* Gaertn.) kommen, der Güte des Oels nach, die verschiedenen Arten von *Oenocarpus* (*Oe. Bacaba*, *Batava*, *disticha* u.s.w.). Das Oel derselben ist anscheinend sogar besser als das des Caiaué. Es ist farblos und süss, nicht allein gut für Lampen, sondern auch für die Küche. In den Läden von Pará mischt man dies von den Indianern gekauft Oel zu gleichen Theilen mit Olivenöl und verkauft das Ganze als letzteres, von welchem es auch in der That von den besten Kennern kaum unterschieden werden kann. Ich bezeuge, dass zum Fischebacken dies Oenocarpusöl sowohl der Butter wie dem Olivenöl gleichkommt'".

(3) "*Oenocarpus Bacaba* Mart. und *Oenocarpus Patawa* S. in Mittel- und Südamerika. Aus den Samen wird das Comuöl, Huile de Comou, Comou Butter, gepresst und zur Seifen- un Kerzenfabrikation verwendet."

(4) "...non seulement pour l'éclairage, mais pour les usages culinaires."

(5) "Coumouöl wird aus den Kernen der folgended beiden Palmenspezies erhalten: *Oenocarpus batana* Mart. und *O. bacaba* Mart. Die Kerne werden mit Wasser ausgekocht, wobei sich ein hellgelbes Öl ausscheidet. Das Öl wird als ein halbtrocknendes Öl beschrieben. Die untersuchte Probe enthielt 4,3 Proz. freier Fettsäuren. Die auszerordentlich niedrige Verseifungszahl stimmt nicht mit der Angabe Bassières überein, dasz die Probe 10,4 Proz. Glycerin lieferte und dasz das Molekulargewicht der Fettsäuren 289,1 betrug. Auch kann die Angabe, dasz die Probe nur 19 Proz. Ölsäure enthielt, nicht richtig sein. Der Schmelzpunkt der Fettsäuren liegt bei 19°".

(6) "*O. batava*. Das Fruchtfleisch ist geniessbar. Der in trockenem Zustande aussen hellbraune, innen weisse Samen liefert bei der Extraktion mit Aether 34,8 % eines hellgelben, schwach trocknenden Oels ohne Geruch und mit angenehmen Geschmack. Es wird in der Literatur erwähnt unter den Namen: Comuöl, Huile de Comou, Comou Oil. Die Untersuchung ergab folgendes Bild: Spez. Gewicht 0,9248 (15°); Schmelzpunkt -7,5°; Erstarrungspunkt -9°; Brechungsindex 1,4691 (15°); Säurezahl 1,40; berechnet auf freie Oelsäure 0,71 % ; Verseifungszahl 190,5; Esterzahl 189,1; Iodzahl (Wijs) 80,0; Fettsäure 96,06 %; Glycerin 10,33 %; Unverseifbares 0,76%. Die aus den Oel gewonnenen Fettsäuren sind hellgelb und von butterartige Konsistenz. Schmelzpunkt 19,5°; Estarrungspunkt 17,8°; Brechungsindex 1,4502 (45°); Neutralisationszahl 190,2; Iodzahl (Wijs) 85,3; Mittleres Molekulargewicht 292,2. Die Extraktionsrückstand enthält 32,15 % Protein."

(7) "192. *Oenocarpus Batava* Mart. -- Brasilien. -- Früchte (Kern) liefern fettes Oel (Comuöl, Coumouöl, Patavaöl, s. folgender Art.).
"193. *O. bacaba* Mart. -- Südamerika. -- Wie vorige Art aus Fruchtkernen Comuöl. Im Endosperm verschiedene Mannane, ein Galaktan, Saccharose 1), das Comuöl enth. Olein neben Glyzeriden fester Fettsäuren u. freie Säuren 2)....1) LIÉNARD, s. Nr. 191, Note 4 [=Liénard, Compt. Rend. 135: 593. 1902]. 2) BASSIERE, J. Pharm. Chim. 1903. 323; cf. Lewkowitsch, Technologie d. Fette. II. Bd. 1905. 125."

(8) "Coumou oil 3), batava oil 4). French - Huile de coumou. German - Comuöl. Italian - olio di coumou. Coumou oil is obtained from the kernels of the palm trees: *Oenocarpus batava*, Mart., *OE. bacaba*, Mart., which frequently occur in tropical South America and bear a berry-like fruit, which ripens all through the year. The kernels are boiled out with water, when a pale yellow limpid oil - 'coumou oil' - rises. Grimme 1) ascertained the following characteristics: oil -- specific gravity at 15° C. 0.9248; solidifying point -9° C.; melting point -7.5° C.; saponification value 190.5; iodine value 80.0; refractive index at 15° C. 1.4691. Fatty acids -- insoluble acids and unsaponifiable 96.06 %; unsaponifiable 0.76 %; solidifying point 17.8; melting point 19.5; neutralization value 190.2; iodine value 85.3; refractive index at 45° 1.4502......lesser known vegetable fats....*OE. distichus* - S. Am. - 7.1 % yield; melting point 36; saponification value 209.2; iodine value 55.0; refractive index 49.0 at 40° C."

(9) The "Index Kewensis" and its 8th and 9th supplements, plus the Gray Herbarium's Card Index of New Species, list 26 accepted species in *Oenocarpus*, and about a dozen excluded names. Burrett in 1928 accepts as valid only eleven species in the genus *Oenocarpus*.

(10) "Aus den Früchten wird ein beliebtes Getränk gewonnen, das indessen wegen das starken Olgehalts schwer verdaulich ist."

(11) "387. *Oenocarpus Batava* Mart. 'Patava'. - Brasilien - Früchte (Kern) 4,8 % fettes Oel, Comuöl (Coumouöl, Patavaöl, s. folgende). GRIMME, Chem. Rev. Fett-Ind. 1910. 17. 233 (C.C. 1910. II. 1713).
"388. *O. bacapa* Mart. - Südamerika. - Wie vorige Art aus Fruchtkernel Comuöl mit Olein, Glyzeriden fester Fettsäure u. freie Säuren 2). Endosperm verschied. Mannane, e. Galacten, Saccharose 1)......1) LIÉNARD, S. Nr. 386. Note 4 [= Liénard, Compt. Rend. 135: 593. 1902]. 2) BASSIÈRE, J. Pharm. Chim. 1903. 323. cf. LEWKOWITSCH, Technologie d. Fette. II. Bd. 1905. 125.
"389. *O. disticha**. - Tropen - Samen mit 7,1% fett. Oel. BOLTON a. JESSON, Analyst 1915. 40. 3 (C.C. 1915. I. 550). Constanten."

(12) "Das zweite Oel war schön hellgelb, zeigte keinen Geruch und hatte angenehmen Geschmack. Es wurde als 'Oenocarpusöl' bezeichnet und soll von einer Palmenart gewonnen werden. Die Konstanten waren: Spez. Gewicht 15° C. 0,9244; Erstarrungspunkt 7,5° C.; Brechungsindex 1,4700; Säurezahl 1,38; Verseifungszahl 190,0; Jodzahl n. Wijs 80,6; Unverseifbares 0,84%. An Fettsäuren waren in dem Oel 96 % enthalten. Sie zeigten: Schmelzpunkt 18,9° C.; Brechungsindex 45° C. 1,4492; Jodzahl n. Wijs 86,7. Das Oel konnte durch Bleicherde 'Tonsil' vollständig farblos erhalten werden. Auch hier handelt es sich um ein schwach trocknendes Oel, dessen Trockeneigenschaft aber durch Zusatz Kobaltsikkativ etwas verbessert werden konnte. Nach unseren Auschauungen genügt aber trotzdem die Trockenfähigkeit nicht."

(13) "Ueber einige weniger bekannte brasilianische Palmöle."

(14) "774. *Oenocarpus*-Species (nicht angegeben) (Fam. *Palmae*). s. z. Aufl. 1. 124. Das Oel enth. 0,84% Unverseifbares (=unsaponifiables) 1). -- Ueber fette Oele von *Oenocarpus*, *Euterpe* u. a. Palmenarten Brasiliens s. Unters. 2).....
1) Stock, s. *Moquilia tomentosa*, Constanten des Oeles [=Farbenzeit. 36: 830. 1931]. 2) Friese, Chem. Umschau Fette u Oele etc. 1931. 38: 216 (C.C. 1931. II. 2235)."